decomposing the ether-soluble lead salts, the free acids can be isolated and purified as indicated above.

Summary.—All of the various lipoid fractions isolated from tubercle bacilli possess the property of stimulating the proliferation of monocytes, epithelioid and giant cells and the subcutaneous injection of these products leads to the formation of tubercular tissue. The factors responsible for this reaction have been identified as certain liquid saturated fatty acids. The substance possessing the greatest biological activity is a dextrorotatory fatty acid of the formula $C_{26}H_{52}O_2$ which has been named phthioic acid.

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A HOMOZYGOUS TRANSLOCATION IN DROSOPHILA MELANOGASTER

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Five cases of translocation involving the third and the fourth chromosomes of *Drosophila melanogaster* have been found in the progeny of flies treated by x-rays. The flies carrying a given translocation seem to be perfectly normal in their appearance, but, when tested genetically, they show linkage of genes belonging to the third with genes belonging to the fourth linkage group. Thus, males heterozygous for a given translocation and for the third-chromosome dominant gene, Dichaete, and the fourth-chromosome recessive eyeless (i.e., Dichaete non-eyeless in appearance) when crossed to homozygous eyeless females from regular stock give only Dichaete non-eyeless and eyeless offspring, but no Dichaete eyeless and no wild-type offspring. Dichaete males from this mating give the same

result again, if mated to homozygous eyeless females. The stocks of the translocations are maintained, in heterozygous condition, by crossing in each generation Dichaete males heterozygous for the translocation to regular eyeless females.

Genetical and cytological study of these translocations showed that in each of them one member of the pair of larger V-shaped autosomes (obviously the genetical third chromosome) is broken into two parts of unequal length, and the shorter part is attached to the small round chromosome (the fourth chromosome).

It has been found genetically that in two cases the third chromosome is broken between the loci of the genes Dichaete and thread. In these cases the oögonial metaphase plates show one of the larger V-shaped autosomes with one limb markedly shortened (presumably this shortening represents the absence of the part of the third chromosome containing the loci to the left of thread) and a short rod-shaped chromosome not present at all in the normal chromosome group of the species. This rod-shaped chromosome is the translocated fragment of the third chromosome containing the loci from Dichaete to the left end of the chromosome, attached to the fourth chromosome. Only one free spherical fourth chromosome is found in most plates.

In a third case the genetical data suggested that the third chromosome has been broken very near its extreme right end (to the right of claret) and a very small piece of it has become attached to the fourth chromosome. In cytological preparations in this case the third chromosomes appear normal but one of the fourth chromosomes is slightly increased in size.

In a fourth case the third chromosome is broken between scarlet and pink, i.e., nearer to the middle of the chromosome than in the first two cases described above. Cytologically, two fragments of the larger autosome are found. One of them is longer and J-shaped (presumably it contains the loci from pink to the right end of the chromosome), and the other is shorter and rod-like (presumably it is the fragment carrying the loci from scarlet to the left end of the chromosome attached to the fourth chromosome). Only one free fourth chromosome is present in most plates.

Finally, in the fifth case the breaking point of the third chromosome is located genetically between the genes pink and curled. The cytological situation in this case is essentially like that in the preceding one, but in this case the J-shaped chromosome appears a little longer, and the rod-shaped chromosome appears a little shorter than in the preceding case. Here, the J-shaped chromosome contains the genes located in the normal third chromosome to the left of pink, and the rod-shaped carries the genes located from curled to the right end of the third chromosome. The rod-

shaped chromosome in this case also must include the material normally located in the fourth chromosome.

In general these results showed that the size of the fragments of the third chromosome as seen cytologically is roughly proportional to their size as estimated on the basis of genetical data.

In the fourth case described above, the rod-shaped fragment of the third chromosome is more than twice as long as in the first and the second cases. But when estimated genetically it is not more than one-fifth longer in the fourth case than in the first and the second. These discrepancies may be easily explained by the assumption that in the middle of the third chromosome crossing-over is relatively lower per unit of the actual chromosome length, and accordingly the distances between the genes in the middle part of the third chromosome are represented by the genetical map of this chromosome as relatively closer together than they are in the chromosome itself. On the other hand, the actual distances between the genes located near the ends of the chromosome are exaggerated by the genetical map.*

A considerable amount of work has been done in the endeavor to secure some of the translocations in homozygous form. As pointed out by Muller (1928), the majority of the translocations are unviable when homozygous. The reasons for this are not yet understood. It seems to be possible that a breakage of a chromosome, which is necessary for the occurrence of a translocation, may take place only in case the chromosome is previously injured by some agent. Or, to the contrary, the breakage itself is likely to do some injury to the chromosome. Anyway this rule is not necessarily true, since out of the five cases of translocation described above, two cases (the fourth and the fifth) give rise to individuals homozygous for the translocation.

In the fourth case (in which the third chromosome is broken between scarlet and pink) flies homozygous for the translocation appear to be somatically normal. The males are fairly fertile, but females seem to be completely sterile, having rudimentary ovaries with no egg-chambers formed.

In the fifth case (the third chromosome is broken between pink and curled) the flies homozygous for the translocation are seemingly normal morphologically and are fertile in both sexes, though the fertility of the females is lower than in wild-type flies or in heterozygous translocation.

The chromosomes of the females homozygous for this translocation have been studied. Seven sufficiently clear oögonial metaphase plates all present the same peculiar condition described below. One pair of normal-looking rod-shaped X-chromosomes and one pair of V-shaped second chromosomes are present. No small round fourth chromosomes have been found in the plates studied. One pair of J-shaped chromosomes and one

pair of rod-shaped chromosomes (which are shorter than the X-chromosomes) are invariably present in the plate. These J-shaped and rod-shaped chromosomes are beyond doubt the fragments of the larger V-shaped autosome of the normal fly (the third chromosome), the rod-shaped chromosome containing also the fourth chromosome, which provides a spindle fiber attachment.

The pair of the J-shaped chromosomes of the homozygous translocation shows somatic pairing with each other; the same is true in respect to the smaller rod-shaped pair. But the J-shaped and the rod-shaped chromosomes do not manifest any attraction to each other, in spite of the fact that they are both fragments of the same chromosome of the normal fly. This suggests that the phenomenon of somatic pairing, characteristic of the chromosomes of Diptera, is due rather to attraction between homologous parts of the chromosomes than to attraction between the chromosomes as entities.

Taken as a whole, the chromosomal complex of the homozygous translocation looks so different from the complex of the normal fly of the species *Drosophila melanogaster* that probably most observers would recognize in it a different species. In fact, it seems to be more like the chromosomal complex of *Drosophila immigrans* Sturt. (Morgan, Bridges, Sturtevant, 1925, Fig. 60*D*) or to that of *Drosophila melanica* (loc. cit., Fig. 60*E*). Nevertheless, as mentioned above, the homozygous translocation is scarcely different from the normal fly in external appearance. This shows that the properties of the organism are determined not by the form or the shape of the chromosomes, but rather by the content of the chromosomes, i.e., the genes.

Since the homozygous translocation has the third chromosome of the normal fly broken into two parts, it might be expected that in crosses the genes located in different fragments would show no linkage but would show complete independence of each other. The breakage occurred between the genes pink and curled. Therefore the loci from pink to the left end of the chromosome must constitute one linkage group (corresponding to the J-shaped chromosome of the translocation), and the loci from curled to the right end of the map of the chromosome must form another linkage group (corresponding to the rod-shaped chromosome of the translocation). In other words the third-chromosome linkage group of *Drosophila melanogaster* must in this case be broken into two independent linkage groups. The following experiment shows that this is really the case.

Flies have been secured which were homozygous in respect to the translocation but heterozygous in respect to the following genes belonging to the third linkage group of the normal fly: recessives roughoid (*ru*), hairy (*h*), thread (*th*), scarlet (*st*), sooty (e^s), claret (*ca*) and a dominant Dichaete

(*D*). Males of the above genetical composition have been crossed to normal (i.e., not carrying translocation) females homozygous for *ru, h, th, st, e*^{s} and *ca*. This cross may be represented as follows:

$$\frac{ru\ h\ +\ th\ st}{ru\ h\ +\ th\ st}\ \frac{e^s\ ca}{e^s\ ca}\ \text{♀} \times \frac{ru\ h\ +\ th\ st}{++\ D\ ++}\ \frac{e^s\ ca}{++}\ \text{♂}.$$

If the third chromosome of the above male were not broken, the progeny of this cross would consist of *ru h th st e*^{s} *ca* and of *D* individuals only. But the breakage should allow *ru h th st* and *D e*^{s} *ca* individuals also to appear, so that the offspring should consist of the above four classes in equal numbers. The results obtained in the experiment are:

	ru h th st e^s *ca*	*ru th h st*	*D e*^{s} *ca*	*D*
Observed	227	243	238	232
Expected	235 ± 13.2	235 ± 13.2	235 ± 13.2	235 ± 13.2

There can be no escape from the conclusion that the standard third chromosome linkage group, following the break of the visible third chromosome, has become also broken into two independent linkage groups. It necessarily follows that the different parts of the visible third chromosome contain different genes.

As is well known, in males of Drosophila the linkage between the genes belonging to the same linkage group is complete, but in females crossing-over occurs. The above experiment shows that in males of the homozygous translocation there is no crossing-over within either of the "new" linkage groups. It becomes interesting to find whether in females homozygous for the translocation there is crossing-over, and if so, what is the frequency of it between the different genes as compared with the frequency of crossing-over between the same genes in ordinary flies. An experiment was arranged as follows:

$$\frac{ru\ h\ +\ th\ st}{++\ D\ ++}\ \frac{e^s\ ca}{++}\ \text{♀} \times \frac{ru\ h\ +\ th\ st\ e^s\ ca}{ru\ h\ +\ th\ st\ e^s\ ca}\ \text{♂}$$

The crossing-over within the "new" linkage groups did occur. The frequencies of recombination may be seen in the following table:

INTERVAL	% IN HOMOZYGOUS TRANSLOCATION	STANDARD %	DIFFERENCE
ru – *h*	27.8	26.5	+ 1.3
h – *D*	14.4	13.9	+ 0.5
D – *th*	1.2	1.8	– 0.6
th – *st*	1.5	1.8	– 0.3
st – *e*^{s}	46.5	26.7	+19.8
e^s – *ca*	31.1	30.0	+1.1

Since the break of the third chromosome occurred between scarlet and sooty (more exactly between pink and curled), 50% of recombinations would be expected. In fact, there is observed 46.5% of recombinations. In all intervals in which the crossing-over frequencies have been studied in the homozygous translocation, the crossing-over values are but slightly, if at all, different from the standard.

* These results in a more extended form are in publication in *Biologisches Zentralblatt.* Independently Muller and Painter have come to similar results on the basis of study of numerous translocations obtained by them in *Drosophila* (Muller and Painter, 1929).

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MAGNETIC SUSCEPTIBILITY OF NITRIC OXIDE AT 296°K. AND 216°K.

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In the course of attempts to improve and simplify present methods for measuring the magnetic susceptibility of gases, the following observations on the susceptibility of NO were made, and as the work is being continued on entirely different lines, it is proposed to publish this result separately in a short paper.

Apparatus.—The method is essentially that of hanging a test body surrounded by the gas to be measured in an inhomogeneous magnetic field, as it has been used by Glaser,[2] Vaidyanathan,[3] Hammar,[4] and others. The chief improvement lies in getting rid of the relatively enormous forces on the test body without having recourse to paramagnetic substances, which make the apparatus so sensitive to small temperature changes. Figure 1 shows the essential features of the test body. It is made entirely of pyrex glass, the parts being fused together. P represents the pole pieces of the magnet,[5] and the position of the test body as shown is an equilibrium position with a vacuum inside and outside the tubes ABCD. The tubes A and B are connected with the surrounding gas through the tube E which is hooked to a quartz fiber suspension. The tubes C and D can be sealed off at F. In the following